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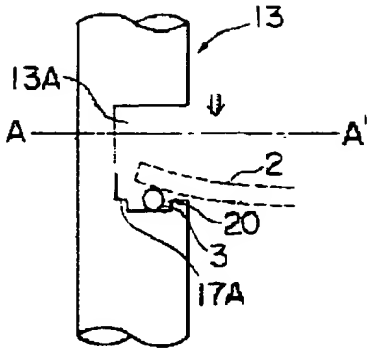
TITLE : THERMAL TREATMENT JIG



ABSTRACT : PROBLEM TO BE SOLVED: To lessen a contact stress and a friction stress imposed on a silicon wafer at heating by a method wherein a movable support which absorbs the deformation of a semiconductor wafer at a thermal treatment is provided in each of support sections provided to support poles at a right angle with their axes, where the supports are arranged at a regular interval.

SOLUTION: A thermal treatment jig is equipped with supports 13 which are each provided with a support section vertical to its axis and provided at a regular interval, and a silicon wafer 2 is put in a space surrounded with the supports 13 and supported by the support sections, wherein cutouts 13A are made to serve as the above support sections to indirectly support the peripheral part of the silicon wafer 2 from below. A movable spherical support 3 is placed on the lower surface 17A of each of the cutouts 13A to support the silicon wafer 2. Furthermore, a flat-bottomed recess 20 is provided so as to make the movable support 3 stay within a prescribed range. By this setup, when the silicon wafer 2 is deformed under its own weight or by heating, the movable support 3 is freely rolled in the recess 20 with the deformation of the silicon wafer 2, so that a friction can be restrained from occurring in a contacting surface between the silicon wafer 2 and the movable support 3.

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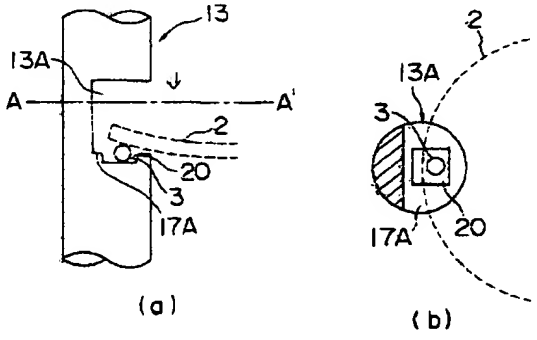
(54)【発明の名称】　熱処理用治具

(57)【要約】

【課題】　加熱時にシリコンウェーハに生じる接触応力や摩擦力を低減し、シリコンウェーハ材料特性や信頼性を維持しうる熱処理用治具を提供する。

【解決手段】　本発明の熱処理用治具は、軸に垂直な支持部１３Ａ～１６Ａを所定間隔で備えた複数の支柱１３～１６を、支持部が円板状の半導体ウェーハ２の周縁部に係合するようにかつ各軸が鉛直方向に平行になるように配設したものであって、各支持部に、半導体ウェーハの熱処理時の変形を吸収する可動支持体３を備えたことを特徴とする。また本発明の熱処理用治具は、軸に垂直な支持部１１３Ａ～１１６Ａを所定間隔で備えた複数の支柱１１３～１１６を、支持部が円板状の半導体ウェーハ２の周縁部に係合するようにかつ各軸が水平方向に平行になるように配設したものであって、各支持部に、半導体ウェーハの外縁に係合してウェーハ表面の熱処理時の変化に追随する可動支持体３０を備えたことを特徴とする。



ハ2との接触面積が小さくなる場合（図7（b）参照）、シリコンウェーハ2に加わる接触応力が大きくなる。

【0010】すなわち、室温に比べて高温下では、単結晶シリコンの弾性率と降伏応力とはそれぞれ低くなる。弾性率が低くなるとウェーハは変形しやすくなり、降伏応力が低くなると転位（スリップ）が生じやすくなる。そのため、シリコンウェーハの熱処理では、低弾性率化によって、自重でもウェーハが変形するようになる。この変形によって、切欠部13Aとシリコンウェーハ2との接触面積が小さくなり、シリコンウェーハ2に作用する局部の接触圧力は大きくなる。更に、降伏応力も低くなるため、転位（スリップ）が生じやすくなる。

【0011】更に、シリコンウェーハ2の変形により切欠部13Aとシリコンウェーハ2との接触点30が移動するため（図7（b）参照）、シリコンウェーハ2に摩擦力が生じる。

【0012】また、この接触応力や摩擦力は、支柱13～16、天井板11、底面板12、及びシリコンウェーハ2の熱変形動作がそれぞれ異なる場合、すなわちシリコンウェーハの最終的な熱処理温度における熱膨脹差が異なる場合や、あるいは最終的な熱処理温度における熱膨脹差が異ならないとしても、昇温中（あるいは降温中）のある時点の温度において熱膨脹差が異なる場合に、更に増大する。

【0013】これら接触応力や摩擦力はシリコンウェーハ2にスリップやキズ、塵埃を生じさせ、これらのスリップやキズはシリコンウェーハ2の材料特性や信頼性を損う原因となる。

【0014】また、上述した横型拡散炉に用いられる従来の熱処理用治具では以下のような問題点が生じる。

【0015】図9の切欠部114A付近の部分拡大図に示すように、加熱に伴い降伏応力が小さくなるため、シリコンウェーハ2が自重により横方向に変形しやすくなる。この変形によって、シリコンウェーハ2が切欠部114Aに対して斜めになり、シリコンウェーハ2と切欠部114Aとの接触面積が小さくなり（図9参照）、シリコンウェーハ2に加わる接触応力が大きくなる。

【0016】また、シリコンウェーハ2の変形により切欠部114Aとシリコンウェーハ2との接触点130が移動するため、シリコンウェーハ2に摩擦力が生じる。

【0017】また、この接触応力や摩擦力は、支柱113～116、底面板111、112、及びシリコンウェーハ2の熱変形動作がそれぞれ異なる場合、すなわちシリコンウェーハの最終的な熱処理温度における熱膨脹差が異なる場合や、あるいは最終的な熱処理温度における熱膨脹差が異ならないとしても、昇温中（あるいは降温中）のある時点の温度において熱膨脹差が異なる場合に、更に増大する

【0018】これら接触応力や摩擦力は、前述した従来の縦型拡散炉に用いられる熱処理用治具と同様に、シリコンウェーハ2にスリップやキズ、塵埃を生じさせ、これらのスリップやキズはシリコンウェーハ2の材料特性や信頼性を損う原因となる

【0019】そこで本発明の目的は、加熱時にシリコンウェーハに生じる接触応力や摩擦力を低減し、シリコンウェーハ材料特性や信頼性を維持しうる熱処理用治具を提供することである。

【0020】

【課題を解決するための手段】本発明の熱処理用治具は、軸に垂直な支持部を所定間隔で備えた複数の支柱を、支持部が円板状の半導体ウェーハの周縁部と係合するようにかつ各軸が鉛直方向に平行になるように配設したものであって、各支持部に、半導体ウェーハの熱処理時の変形を吸収する可動支持体を備えたことを特徴とする。

【0021】このように半導体ウェーハを支持する可動支持体が、半導体ウェーハの変形を吸収するように動くため、半導体ウェーハに生じる接触応力や摩擦力を低減することができる。

【0022】本発明の熱処理用治具は、可動支持体が球状あるいは略円筒状の形状を有することを特徴とする。

【0023】このように可動支持体が半導体ウェーハの変形に合わせてその変形を吸収するように回転するため、半導体ウェーハに生じる接触応力や摩擦力を低減することができる。

【0024】本発明の熱処理用治具は、支持部の半導体ウェーハの支持面に、可動支持体を所定の範囲に制限する凹部が形成されていることを特徴とする。

【0025】このように、凹部を形成するため、可動支持体を所定の範囲にとどめておくことが可能になる。

【0026】本発明の熱処理用治具は凹部の底面が前記支持面と平行に形成されていることを特徴とする。

【0027】このように、溝を形成するため可動支持体を所定の範囲にとどめておくことが可能になる。

【0028】本発明の熱処理用治具は溝の底面が下に凸状に形成されていることを特徴とする。

【0029】このように、溝の底面が下に凸状を有するため、可動支持体の位置決めをすることが可能になる。

【0030】本発明の熱処理用治具は、軸に垂直な支持部を所定間隔で備えた複数の支柱を、支持部が円板状の半導体ウェーハの周縁部と係合するようにかつ各軸が水平方向に平行になるように配設したものであって、各支持部に、半導体ウェーハの外縁に係合してウェーハ表面の熱処理時の変化に追随する可動支持体を備えたことを特徴とする。

【0031】このように、半導体ウェーハを支持する可動支持体が、半導体ウェーハの変形に合わせて、その変形を吸収するように動くため、半導体ウェーハに生じる接触応力や摩擦力を低減することができる。

て、直径２０ｃｍ、厚さ０．７２５ｍｍのシリコンウェーハを、１２００度Ｃの水素雰囲気の縦型拡散炉に入れて１時間の熱処理を施した。

【００５２】両方の熱処理用治具を使用して加熱したシリコンウェーハに発生したスリップ率を比較した（図１０の図表を参照）。従来の熱処理用治具を使用した場合（スリップ発生率１００）に比べ、この形態による熱処理用治具を使用した場合（スリップ発生率２０）の方が、大幅にスリップの発生率を防止できた。

【００５３】なお、図３（ａ），（ｂ）に示すように、凹部２０ｂの溝幅を球状の可動支持体３の直径より小さくすることにより、可動支持体３が径方向に対しては自由に動けるようにする一方で、径方向以外に対しては動きを拘束するようにすることができる。

【００５４】次に、本発明に係る熱処理用治具の実施の形態を図４を参照して説明する。

【００５５】図４（ａ）は、熱処理用治具の１つの切欠部１３Ａ付近を示した部分正面図であり、図４（ｂ）は図４（ａ）の断面Ｃ－Ｃ′を矢印方向から見た切欠部１３Ａの平面図である。

【００５６】図４（ａ），（ｂ）に示すように切欠部１３Ａの下面１７Ａにはシリコンウェーハ２を面支持するガイド４が設けられ、ガイド４は支点４０を中心にしてその上面の水平面となす角度がある範囲で変化できるように軽着されている。このようなガイド４は各切欠部毎に設けられている。

【００５７】この実施の形態では、シリコンウェーハ２が変形する時でも、その変形を吸収するようにガイド４が動くため、シリコンウェーハ２に生じる摩擦を避けることができる。

【００５８】またガイド４はシリコンウェーハ２を面で支持するため、上述した形態に比較して、シリコンウェーハ２に加わる応力集中を小さくすることができる。

【００５９】ここで、実際に直径２０ｃｍ、厚さ０．７２５ｍｍのシリコンウェーハを、この形態のように炭化珪素からなるガイドに載置して、１２００度Ｃの水素雰囲気の縦型拡散炉に入れて１時間の熱処理を施した。また、比較のために従来のような切欠部の下面で直接シリコンウェーハを支持する熱処理用治具を使用して、直径２０ｃｍ、厚さ０．７２５ｍｍのシリコンウェーハを、１２００度Ｃの水素雰囲気の縦型拡散炉に入れて１時間の熱処理を施した。

【００６０】両方の熱処理用治具を使用して加熱したシリコンウェーハに発生したスリップ率を比較した（図１０の図表を参照）。従来の熱処理用治具を使用した場合（スリップ発生率１００）に比べ、この形態による熱処理用治具を使用した場合（スリップ発生率４０）の方が、大幅にスリップの発生率を防止できた。

【００６１】次に、横型熱拡散炉に使用される熱処理用治具について説明する。

【００６２】本発明に係る熱処理用治具の実施の形態を図５を参照して説明する

【００６３】図５（ａ）は、熱処理用治具の１つの切欠部１１３Ａ付近を示した部分正面図であり、図５（ｂ）は図５（ａ）の断面Ｄ－Ｄ′を矢印方向から見た切欠部１１４Ａの正面図である。

【００６４】この形態による熱処理用治具の支柱の構成は、従来の技術で説明したものと同様である。すなわち、図８に示すように、熱処理用ボート１００は、バッチ型ボートであり、左右にそれぞれ対向して配置された円形の底面板１１１，１１２の間に、例えば４本の支柱１１３～１１６が水平方向に設けられている。

【００６５】各支柱１１３～１１６の間には、複数のシリコンウェーハ２を垂直に挿入し、シリコンウェーハ２の周縁部を支えるように、切欠部１１３Ａ～１１６Ａ，１１３Ｂ～１１６Ｂ，……が備えられている。そのため、各支柱１１３～１１６はシリコンウェーハ２の下半分の外周に位置し、支柱１１３及び支柱１１６は、ほぼシリコンウェーハ２の直径に相当する所に位置し、支柱１１４及び支柱１１５は支柱１１３及び支柱１１６の間のシリコンウェーハ２の下側の外周部に位置している。

【００６６】図５（ａ），（ｂ）に示すように切欠部１１４Ａにはシリコンウェーハ２を支持する可動支持体３０が設けられている。可動支持体３０は、シリコンウェーハ２の変形を吸収するように、すなわち支点４０を中心にしてシリコンウェーハ２の表面となす角度がある範囲で変化できるように支柱１１４に軽着されている。可動支持体３０のシリコンウェーハ２の支持部分には、シリコンウェーハ２の厚さよりやや幅が広い支持口４１が形成されている。このような支持口４１を有する可動支持体３０は各切欠部毎に設けられている。

【００６７】この実施の形態では、シリコンウェーハ２が加熱により変形する時でも、シリコンウェーハ２の変形に伴い、可動支持体３０がその変形を吸収するように動くため、シリコンウェーハ２に生じる摩擦を避けることができる。更に、シリコンウェーハ２が変形しても、シリコンウェーハ２と支持部とが面接触を保ち、また接触応力も増加しない。

【００６８】ここで、実際に直径２０ｃｍ、厚さ０．７２５ｍｍのシリコンウェーハを、この形態のように炭化珪素からなる直径１０ｍｍの球状の可動支持体に載置して、１２００度Ｃの水素雰囲気の横型拡散炉に入れて１時間の熱処理を施した。また、比較のために従来のような切欠部の面で直接シリコンウェーハを支持する熱処理用治具を使用して、直径２０ｃｍ、厚さ０．７２５ｍｍのシリコンウェーハを、１２００度Ｃの水素雰囲気の横型拡散炉に入れて１時間の熱処理を施した。

【００６９】両方の熱処理用治具を使用し、加熱したシリコンウェーハに発生したスリップ率を比較した（図１０の図表を参照）。従来の熱処理用治具を使用した場合

（スリップ発生率１００）に比べ、この形態による熱処理用治具を使用した場合（スリップ発生率８５）の方が、スリップの発生率を減少できた

【００７０】なお、可動支持体はシリコンウェーハの平面の変化を吸収できる態様ならどのようなものでもよい。

【００７１】

【発明の効果】本発明によれば、加熱時にシリコンウェーハに生じる接触応力や摩擦力を低減し、シリコンウェーハ材料特性や信頼性を維持しうる熱処理用治具を提供することができる。

【図面の簡単な説明】

【図１】本発明の熱処理用治具による第１の実施の形態を示す部分正面図及び断面Ａ－Ａ′を矢印方向から見た平面図。

【図２】本発明の熱処理用治具による第２の実施の形態を示す部分正面図及び断面Ｂ－Ｂ′を矢印方向から見た平面図。

【図３】本発明の熱処理用治具による第２の実施の形態を示す部分正面図及び断面Ａ－Ａ′を矢印方向から見た平面図。

【図４】本発明の熱処理用治具による第３の実施の形態を示す部分正面図及び断面Ｃ－Ｃ′を矢印方向から見た平面図

【図５】本発明の熱処理用治具による第４の実施の形態を示す部分正面図及び断面Ｄ－Ｄ′を矢印方向から見た正面図。

【図６】従来の縦型拡散炉に用いられる熱処理用治具を示す正面図及び支柱部分の構成を示す斜視図。

【図７】図６の切欠部付近を示す部分拡大図。

【図８】従来の横型拡散炉に用いられる熱処理用治具を示す平面図及び支柱部分の構成を示す斜視図。

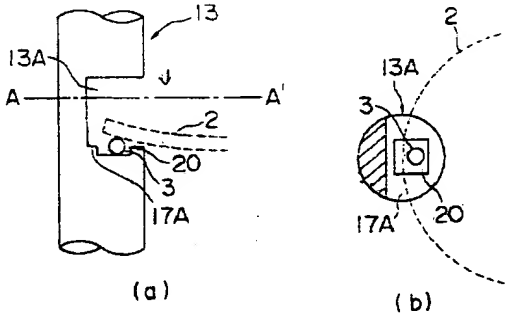
【図９】図８の切欠部付近を示す部分拡大図。

【図１０】従来の熱処理用治具及び本発明による熱処理用治具を使用して熱処理した結果のスリップ発生率を示す図表。

【符号の説明】

１．１００　熱処理用治具
２　シリコンウェーハ
３．３０　可動支持体
４　ガイド
２０．２０ａ　凹部
１３～１６．１１３～１１６　支柱
１３Ａ～１６Ａ．１１３Ａ～１１６Ａ　切欠部

【図１】



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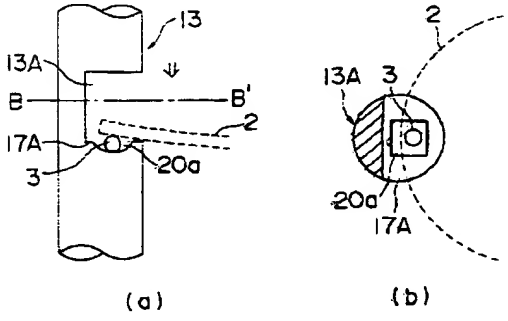

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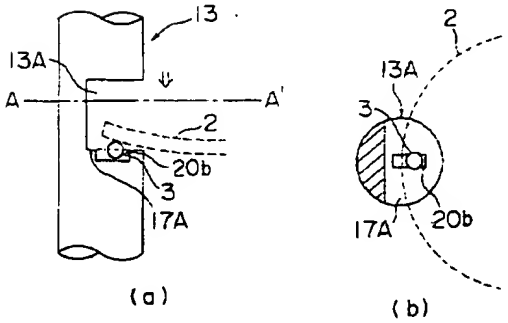

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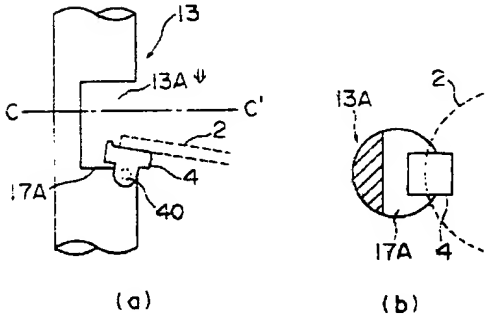

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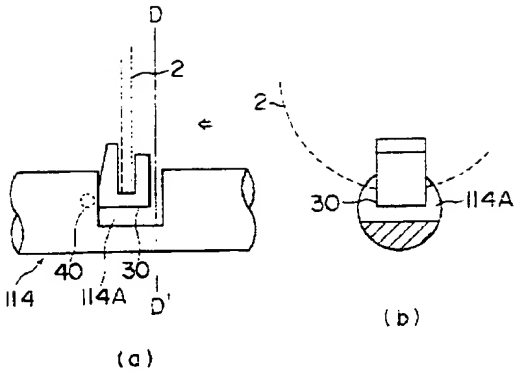

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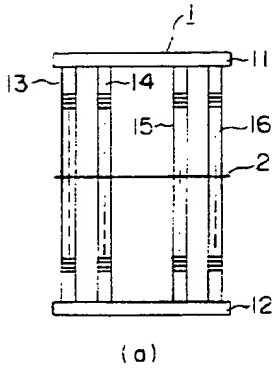

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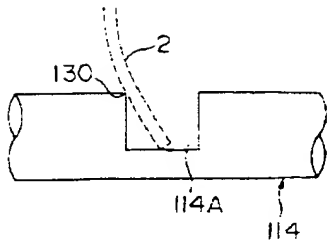

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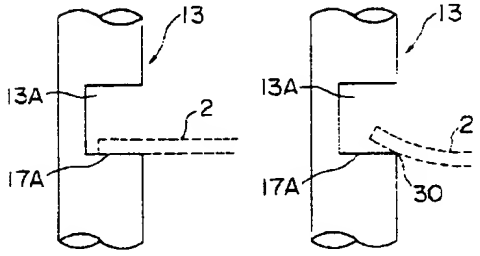

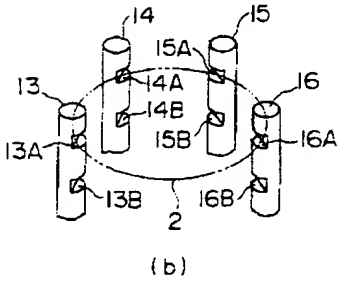

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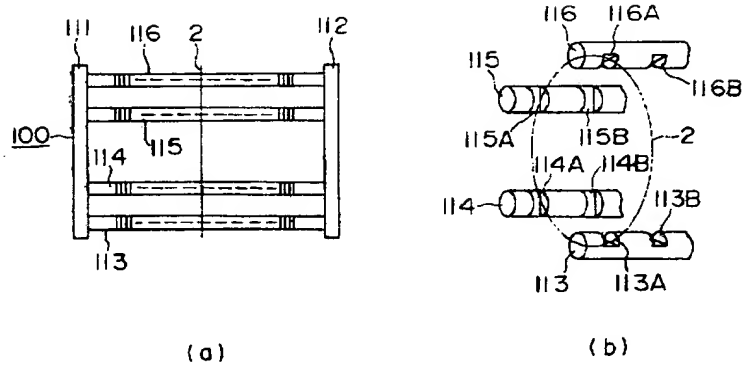

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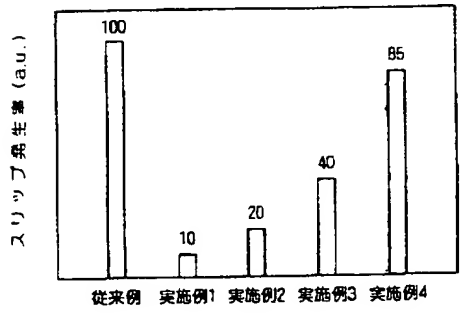

ETAILED DESCRIPTION

)etailed Description of the Invention]
)001]
:ield of the Invention] In case this invention heat-treats to a processed object, especially a disc-like wafer, relates to the fixture for heat treatment which supports a processed object.
)002]
)escription of the Prior Art] With reference to drawing 6 (a) and (b), the conventional fixture for heat eatment used for a vertical mold diffusion furnace is explained. Drawing 6 (a) is the front view showing the xture for heat treatment used for the conventional vertical mold diffusion furnace, and drawing 6 (b) is the erspective view showing the configuration of a stanchion part before long.
)003] This fixture 1 for heat treatment consists of a quartz, silicon, etc., and four stanchions 13-16 with /hich each shaft has been arranged in parallel in the direction of a vertical are formed between circular rown plates 11 and bottom face-plates 12 which countered, respectively and have been arranged up and own so that it may illustrate. Among each struts 13-16, two or more silicon wafers 2 are inserted, and it ıas Notches 13A-16A, 13B-16B, and ..... so that the periphery section of the silicon wafer 2 may be upported from the bottom. Therefore, each struts 13-16 are located in the periphery of the silicon wafer 2. \ stanchion 13 and a stanchion 16 are located in the place which is mostly equivalent to the diameter of the ilicon wafer 2, and the stanchion 14 and the stanchion 15 are located in the periphery section of the silicon vafer 2 between a stanchion 13 and a stanchion 16. Moreover, it has become notching-like and the lirection of notching is a tangential direction of the periphery of the silicon wafer 2 so that Notches 13A-16A, 13B-16B, and ..... can carry out field support of a part of rim section of the silicon wafer 2 from the)ottom.
0004] The fixture 1 for heat treatment with which two or more silicon wafers 2 were inserted is inserted in a /ertical mold diffusion furnace (not shown) as it is, for example, it is heated to 1000 [hundreds -] and ıundreds of degreeC, and required processing is performed.
0005] Next, with reference to drawing 8 (a) and (b), the conventional fixture for heat treatment used for a ıorizontal-type diffusion furnace is explained. Drawing 8 (a) is the top view showing the fixture for heat reatment used for the conventional horizontal-type diffusion furnace, and drawing 8 (b) is the perspective /iew showing the configuration of a stanchion part before long.
0006] This fixture 100 for heat treatment consists of a quartz, silicon, etc., and four stanchions 113-116 /ith which each shaft has been arranged in parallel horizontally are formed between the circular bottom face-plates 111,112 which countered right and left, respectively and have been arranged perpendicularly so hat it may illustrate. Among each struts 113-116, two or more silicon wafers 2 are inserted perpendicularly, and it has Notches 113A-116A, 113B-116B, and ..... so that the periphery section of the silicon wafer 2 bottom may be supported. Therefore, each struts 113-116 are located in the periphery in the lower half of the silicon wafer 2, a stanchion 113 and a stanchion 116 are located in the place which is mostly equivalent to the diameter of the silicon wafer 2, and the stanchion 140 and the stanchion 115 are located in the periphery section of the silicon wafer 2 bottom between a stanchion 113 and a stanchion 116. Moreover, it has become notching-like and the direction of notching is a tangential direction of the periphery of the silicon wafer 2 so that Notches 113A-116A, 113B-116B, and ..... can support a part of rim section of the silicon wafer 2.
[0007] The fixture 1 for heat treatment with which two or more silicon wafers 2 were inserted is inserted in a horizontal-type diffusion furnace (not shown) as it is, for example, it is heated to 1000 [hundreds -] and hundreds of degreeC, and required processing is performed.
[0008]
[Problem(s) to be Solved by the Invention] The following troubles arise in the conventional fixture for heat treatment used for the vertical mold diffusion furnace mentioned above.

0009] Since yield stress becomes small with heating to the silicon wafer 2 and inferior-surface-of-tongue
'of notch 13A A having touched with a fixed area (referring to drawing 7 (a)) before heating as shown in
e partial enlarged drawing near notch 13A of drawing 7 , When it becomes easy to transform the silicon
afer 2 with a self-weight and the touch area of the inferior-surface-of-tongue 17A and the silicon wafer 2 of
)tch 13A becomes small (refer to drawing 7 (b)), the contact stress which joins the silicon wafer 2
ecomes large.
0010] That is, compared with a room temperature, the elastic modulus and yield stress of single crystal
licon become low under an elevated temperature, respectively. If an elastic modulus becomes low, a
afer will be [become] easy to deform, and if yield stress becomes low, it will become easy to produce a
arrangement (slip). Therefore, at heat treatment of a silicon wafer, a wafer comes to deform also by self-
eight by low elastic-modulus-ization. According to this deformation, the touch area of notch 13A and the
licon wafer 2 becomes small, and the contact pressure of the part which acts on the silicon wafer 2
ecomes large. Furthermore, since yield stress also becomes low, it becomes easy to produce a
arrangement (slip).
0011] Furthermore, in order that the point of contact 30 of notch 13A and the silicon wafer 2 may move
ccording to deformation of the silicon wafer 2 (refer to drawing 7 (b)), frictional force arises to the silicon
afer 2.
0012] Moreover, this contact stress and frictional force increase further, when heat deformation actuation
f stanchions 13-16, a crown plate 11, the bottom face-plate 12, and the silicon wafer 2 differs, respectively
.e., when the heat expansion differences in the final heat treatment temperature of a silicon wafer differ),
r when [though the heat expansion differences in final heat treatment temperature do not differ,] heat
xpansion differences differ in the temperature at the time of being in a temperature up (or under a
emperature fall).
0013] These contact stress and frictional force make the silicon wafer 2 produce a slip, and a crack and
ust, and these slips and cracks become the cause which spoils the material property and dependability of
ne silicon wafer 2.
0014] Moreover, the following troubles arise in the conventional fixture for heat treatment used for the
orizontal-type diffusion furnace mentioned above.
0015] Since yield stress becomes small with heating as shown in the partial enlarged drawing near notch
14A of drawing 9 , it becomes easy to transform the silicon wafer 2 into a longitudinal direction with a self-
veight. According to this deformation, the silicon wafer 2 becomes slanting to notch 114A, the touch area of
ne silicon wafer 2 and notch 114A becomes small (refer to drawing 9), and the contact stress which joins
ne silicon wafer 2 becomes large.
0016] Moreover, in order that the point of contact 130 of notch 114A and the silicon wafer 2 may move
ccording to deformation of the silicon wafer 2, frictional force arises to the silicon wafer 2.
0017] Moreover, this contact stress and frictional force increase further, when heat deformation actuation
f stanchions 113-116, the bottom face-plate 111,112, and the silicon wafer 2 differs, respectively (i.e.,
vhen the heat expansion differences in the final heat treatment temperature of a silicon wafer differ), or
vhen [though the heat expansion differences in final heat treatment temperature do not differ,] heat
expansion differences differ in the temperature at the time of being in a temperature up (or under a
emperature fall).
0018] These contact stress and frictional force make the silicon wafer 2 produce a slip, and a crack and
ust like the fixture for heat treatment used for the conventional vertical mold diffusion furnace mentioned
above, and these slips and cracks become the cause which spoils the material property and dependability
f the silicon wafer 2.
0019] Then, the purpose of this invention is offering the fixture for heat treatment which reduces the
contact stress and frictional force which are produced to a silicon wafer, and can maintain a silicon wafer
material property and dependability at the time of heating.
0020]
Means for Solving the Problem] The fixture for heat treatment of this invention is characterized by having
arranged two or more stanchions equipped with the supporter perpendicular to a shaft at intervals of
predetermined so that a supporter might engage with the periphery section of a disc-like semiconductor
wafer, and so that each shaft might become parallel to the direction of a vertical, and having the movable
base material which absorbs the deformation at the time of heat treatment of a semiconductor wafer to
each supporter.
[0021] Thus, since the movable base material which supports a semiconductor wafer moves so that
deformation of a semiconductor wafer may be absorbed, the contact stress and frictional force which are
produced in a semiconductor wafer can be reduced.

)22] The fixture for heat treatment of this invention is characterized by having a configuration spherical [a)vable base material] or approximately cylindrical.
)23] Thus, since it rotates so that a movable base material may absorb the deformation to compensate deformation of a semiconductor wafer, the contact stress and frictional force which are produced in a miconductor wafer can be reduced.
)24] The fixture for heat treatment of this invention is characterized by forming in the back face of the miconductor wafer of a supporter the crevice which restricts a movable base material to the edetermined range.
)25] Thus, in order to form a crevice, it becomes possible to limit a movable base material to the edetermined range.
)26] The fixture for heat treatment of this invention is characterized by forming the base of a crevice in id back face and parallel.
)27] Thus, in order to form a slot, it becomes possible to limit a movable base material to the edetermined range.
)28] The fixture for heat treatment of this invention is characterized by forming the base of a slot in the ape of convex.
)29] Thus, since the base of a slot has the shape of convex, it becomes possible to position a movable ise material.
)30] The fixture for heat treatment of this invention arranges two or more stanchions equipped with the ipporter perpendicular to a shaft at intervals of predetermined so that a supporter may engage with the eriphery section of a disc-like semiconductor wafer, and so that each shaft may become parallel)rizontally, and it is characterized by having the movable base material which engages with the rim of a emiconductor wafer at each supporter, and follows in footsteps of change at the time of heat treatment on e front face of a wafer.
031] Thus, since the movable base material which supports a semiconductor wafer moves to compensate r deformation of a semiconductor wafer so that the deformation may be absorbed, the contact stress and ctional force which are produced in a semiconductor wafer can be reduced.
032] It is characterized by equipping the fixture for heat treatment of this invention with support opening nich a movable base material surrounds a part of rim of a semiconductor wafer, and has width of face a tle larger than the thickness of a semiconductor wafer.
033] Thus, since it moves so that a semiconductor wafer may absorb the deformation in connection with eformation, since the movable base material was equipped with support opening, the contact stress and ctional force which are produced in a semiconductor wafer can be reduced more.
034]
mbodiment of the Invention] Although this invention is a thing about the fixture for heat treatment used for vertical mold thermal diffusion furnace and a horizontal-type thermal diffusion furnace, it explains the cture for heat treatment first used for a vertical mold thermal diffusion furnace.
035] Hereafter, one gestalt of operation of the fixture for heat treatment concerning this invention is kplained with reference to drawing 1 .
036] Drawing 1 (a) is the partial front view having shown near [one] notch 13A of the fixture for heat eatment by this gestalt, and drawing 1 (b) is the top view of notch 13A which looked at section-A-A ' of awing 1 (a) from the arrow head.
037] The configuration of the stanchion of the fixture for heat treatment by this gestalt is the same as that f what was explained by the Prior art. That is, as shown in drawing 6 , the boat 1 for heat treatment is a atch mold boat, and four stanchions 13-16 are formed between circular crown plates 11 and bottom face-lates 12 which countered, respectively and have been arranged up and down.
038] Among each struts 13-16, two or more silicon wafers 2 are inserted, and it has Notches 13A-16A, 3B-16B, and ..... so that the periphery section of the silicon wafer 2 may be indirectly supported from the ottom. Therefore, each struts 13-16 are located in the periphery of the silicon wafer 2, a stanchion 13 and stanchion 16 are located in the place which is mostly equivalent to the diameter of the silicon wafer 2, and ie stanchion 14 and the stanchion 15 are located in the periphery section of the silicon wafer 2 between a tanchion 13 and a stanchion 16.
039] As shown in drawing 1 (a) and (b), as for the fixture 1 for heat treatment, the spherical movable base aterial 3 for which the silicon wafer 2 is supported to inferior-surface-of-tongue 17of notch 13A A is laid,)r example. Furthermore, in order to limit the movable base material 3 to the predetermined range, the revice 20 where a base is even is formed. Such the movable base material 3 and a crevice 20 are repared for every notch.
040] With this gestalt, since the movable base material 3 can roll free inside a crevice 20 in connection

th that deformation even when deforming with the time of the silicon wafer 2 deforming with a self-weight. heating, friction produced into the contact part of the silicon wafer 2 and the movable base material 3 is oidable.

041] Furthermore, since the area of the contact part does not change even if the contact part of the silicon afer 2 and the movable base material 3 moves it, since the movable base material 3 has the spherical stalt, contact stress does not increase.

042] Here, the silicon wafer with a diameter [of 20cm] and a thickness of 0.725mm was actually laid in e spherical movable base material with a diameter of 10mm which consists of silicon carbide like this stalt, it put into the vertical mold diffusion furnace of a 1200-degree C hydrogen ambient atmosphere, id heat treatment of 1 hour was performed. Moreover, the fixture for heat treatment which supports a rect silicon wafer on the inferior surface of tongue of a notch like before for a comparison was used, the icon wafer with a diameter [of 20cm] and a thickness of 0.725mm was put into the vertical mold diffusion rnace of a 1200-degree C hydrogen ambient atmosphere, and heat treatment of 1 hour was performed.

043] The slip ratio generated to the silicon wafer heated using both fixtures for heat treatment was mpared (see the graph of drawing 10). Compared with the case (slip incidence rate 100) where the nventional fixture for heat treatment is used, the direction at the time of using the fixture for heat eatment by this gestalt (slip incidence rate 10) has prevented the incidence rate of a slip sharply.

044] In addition, this movable base material may be an approximately cylindrical configuration that what is ecessary is just the thing of the rolling configuration.

045] Next, another gestalt of operation of the fixture for heat treatment concerning this invention is plained with reference to drawing 2 .

046] Drawing 2 (a) is the partial front view having shown near [one] notch 13A of the fixture for heat eatment, and drawing 2 (b) is the top view of notch 13A which looked at cross-section B-B' of drawing 2) from the arrow head.

047] When the silicon wafer is not carried by forming the base of crevice 20a for limiting the movable ase material 3 to the predetermined range so that it may become a convex configuration, this gestalt could arry out location ****** of the movable base material 3, and is made. Such a movable base material 3 and evice 20a are prepared for every notch.

048] Like the gestalt of the operation which also mentioned above this fixture for heat treatment, since the ovable base material 3 can roll free inside crevice 20a in connection with that deformation even when eforming with the time of the silicon wafer 2 deforming with a self-weight, or heating, friction produced into e contact part of the silicon wafer 2 and the movable base material 3 is avoidable.

049] Moreover, since the area of the contact part does not change even if the contact part of the silicon afer 2 and the movable base material 3 moves it, since the movable base material 3 has the spherical estalt, contact stress does not increase.

050] Furthermore, since crevice 20a has the convex configuration, the movable base material 3 can lways be located in a stabilization location before loading of the silicon wafer 2.

051] Here, the spherical movable base material with a diameter of 10mm which consists of silicon carbide ke this gestalt was actually put on the abbreviation semi-sphere-like crevice, the silicon wafer with a iameter [of 20cm] and a thickness of 0.725mm was laid in this movable base material, it put into the ertical mold diffusion furnace of a 1200-degree C hydrogen ambient atmosphere, and heat treatment of 1 our was performed. Moreover, the fixture for heat treatment which supports a direct silicon wafer on the nferior surface of tongue of a notch like before for a comparison was used, the silicon wafer with a liameter [of 20cm] and a thickness of 0.725mm was put into the vertical mold diffusion furnace of a 1200-legree C hydrogen ambient atmosphere, and heat treatment of 1 hour was performed.

052] The slip ratio generated to the silicon wafer heated using both fixtures for heat treatment was ompared (see the graph of drawing 10). Compared with the case (slip incidence rate 100) where the onventional fixture for heat treatment is used, the direction at the time of using the fixture for heat reatment by this gestalt (slip incidence rate 20) has prevented the incidence rate of a slip sharply.

0053] In addition, while the movable base material 3 enables it to move freely to the direction of a path by naking the flute width of crevice 20b smaller than the diameter of the spherical movable base material 3 as hown in drawing 3 (a) and (b), a motion can be restrained [except the direction of a path].

0054] Next, the gestalt of operation of the fixture for heat treatment concerning this invention is explained vith reference to drawing 4 .

0055] Drawing 4 (a) is the partial front view having shown near [one] notch 13A of the fixture for heat reatment, and drawing 4 (b) is the top view of notch 13A which looked at cross-section C-C' of drawing 4 a) from the arrow head.

0056] As shown in drawing 4 (a) and (b), the guide 4 which carries out field support of the silicon wafer 2 is

rmed in inferior-surface-of-tongue 17of notch 13A A. and the guide 4 is fixed to revolve so that it can ıange focusing on the supporting point 40 in the horizontal plane of the top face, and the range with the :lude angle to make. Such a guide 4 is formed for every notch.
057] Since a guide 4 runs by the gestalt of this operation so that that deformation may be absorbed even ıen the silicon wafer 2 deforms, friction produced to the silicon wafer 2 is avoidable.
058] Moreover, since a guide 4 supports the silicon wafer 2 in a field, it can make small stress ıncentration which joins the silicon wafer 2 as compared with the gestalt mentioned above.
059] Here, the silicon wafer with a diameter [of 20cm] and a thickness of 0.725mm was actually laid in e guide which consists of silicon carbide like this gestalt, it put into the vertical mold diffusion furnace of a 200-degree C hydrogen ambient atmosphere, and heat treatment of 1 hour was performed. Moreover, the :ture for heat treatment which supports a direct silicon wafer on the inferior surface of tongue of a notch :e before for a comparison was used, the silicon wafer with a diameter [of 20cm] and a thickness of 725mm was put into the vertical mold diffusion furnace of a 1200-degree C hydrogen ambient :mosphere, and heat treatment of 1 hour was performed.
060] The slip ratio generated to the silicon wafer heated using both fixtures for heat treatment was ımpared (see the graph of drawing 10). Compared with the case (slip incidence rate 100) where the ınventional fixture for heat treatment is used, the direction at the time of using the fixture for heat eatment by this gestalt (slip incidence rate 40) has prevented the incidence rate of a slip sharply.
061] Next, the fixture for heat treatment used for a horizontal-type thermal diffusion furnace is explained.
062] The gestalt of operation of the fixture for heat treatment concerning this invention is explained with :ference to drawing 5 .
063] Drawing 5 (a) is the partial front view having shown near [one] notch 113A of the fixture for heat eatment, and drawing 5 (b) is the front view of notch 114A which looked at cross-section D-D' of drawing 5 a) from the arrow head.
064] The configuration of the stanchion of the fixture for heat treatment by this gestalt is the same as that f what was explained by the Prior art. That is, as shown in drawing 8 , the boat 100 for heat treatment is a atch mold boat, and four stanchions 113-116 are horizontally formed between the circular bottom face-lates 111,112 which countered right and left, respectively and have been arranged.
065] Among each struts 113-116, two or more silicon wafers 2 are inserted perpendicularly, and it has lotches 113A-116A, 113B-116B, and ..... so that the periphery section of the silicon wafer 2 may be upported. Therefore, each struts 113-116 are located in the periphery in the lower half of the silicon wafer , a stanchion 113 and a stanchion 116 are located in the place which is mostly equivalent to the diameter f the silicon wafer 2, and the stanchion 114 and the stanchion 115 are located in the periphery section of ıe silicon wafer 2 bottom between a stanchion 113 and a stanchion 116.
066] As shown in drawing 5 (a) and (b), the movable base material 30 which supports the silicon wafer 2 ; formed in notch 114A. The movable base material 30 is fixed to revolve by the stanchion 114 so that eformation of the silicon wafer 2 may be absorbed, namely, so that it can change focusing on the upporting point 40 in the front face of the silicon wafer 2, and the range with the include angle to make. he support opening 41 with a little wide width of face is formed in the supporting section of the silicon vafer 2 of the movable base material 30 from the thickness of the silicon wafer 2. The movable base naterial 30 which has such support opening 41 is formed for every notch.
067] Since it moves by the gestalt of this operation in connection with deformation of the silicon wafer 2 o that the movable base material 30 may absorb that deformation even when the silicon wafer 2 deforms vith heating, friction produced to the silicon wafer 2 is avoidable. Furthermore, even if the silicon wafer 2 leforms, the silicon wafer 2 and a supporter maintain field contact, and contact stress does not increase, ither.
0068] Here, the silicon wafer with a diameter [of 20cm] and a thickness of 0.725mm was actually laid in he spherical movable base material with a diameter of 10mm which consists of silicon carbide like this jestalt, it put into the horizontal-type diffusion furnace of a 1200-degree C hydrogen ambient atmosphere, ınd heat treatment of 1 hour was performed. Moreover, the fixture for heat treatment which supports a lirect silicon wafer in respect of a notch like before for a comparison was used, the silicon wafer with a liameter [of 20cm] and a thickness of 0.725mm was put into the horizontal-type diffusion furnace of a 1200-degree C hydrogen ambient atmosphere, and heat treatment of 1 hour was performed.
0069] Both fixtures for heat treatment were used and the slip ratio generated to the heated silicon wafer vas compared (see the graph of drawing 10). Compared with the case (slip incidence rate 100) where the conventional fixture for heat treatment is used, the directions at the time of using the fixture for heat reatment by this gestalt (slip incidence rate 85) have decreased in number the incidence rate of a slip.
0070] In addition, if a movable base material is the mode which can absorb change of the flat surface of a

icon wafer, what kind of thing is sufficient as it.

071]

ffect of the Invention] According to this invention, the contact stress and frictional force which are oduced to a silicon wafer at the time of heating can be reduced, and the fixture for heat treatment which in maintain a silicon wafer material property and dependability can be offered.

ranslation done.]

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